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Driver detection of water quality trends across Mediterranean river basins

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In this study, thirteen physicochemical surficial water variables and four drivers (i.e. monthly aggregated air temperature and streamflow, population density and percentage of agricultural land use) were analysed in three large Mediterranean river basins (i.e. Adige, Ebro, Sava). In particular, the purpose of the analysis is to identify how indicators of water quality and drivers of change coevolve in three large river basins representing the diversity of climatic, soil and water uses conditions observed in southern Europe. Spearman rank correlation, principal component analysis, Mann-Kendall trend test and Sen's Slope estimator were performed in order to (i) analyse long-term time series of water quality data during the period 1990-2015, (ii) detect links between variables patterns and drivers and (iii) compare the river basins under investigation with respect to their vulnerability and resilience to the identified drivers of change. Results show that air temperature, considered as a proxy of climate change, has a significant impact in all basins but in particular in the Adige and Ebro: positive trends of water temperature and negative for dissolved oxygen are found to be correlated with upward trends of air temperatures. The aquatic ecosystems of these rivers are therefore experiencing a reduction in oxygen, which may further worsen in the future given the projected increase of temperature for this century. At the same time, monthly streamflow has been shown to reduce in the Ebro River, thereby decreasing the beneficial effect of dilution, as appears evident from the observed upward patterns of chloride concentration and electrical conductivity. Upward trends of chloride and biological oxygen demand in the Adige and Sava and positive trends of phosphate in the Adige are related to the increase of population and finally phosphates in the Sava and biological oxygen demand in the Ebro are highly correlated with agricultural land use.
The study showed the complex relationships existing between drivers and observed changes in water quality parameters across three large Mediterranean river basins and can represent a reliable tool for decision makers in river basin planning by providing an overview of the potential impacts of ongoing climatic changes or of particular policies on the aquatic ecosystem under investigation.